WHAT IS CLAIMED IS:

1. An exposure apparatus for exposing a transfer pattern of a mask onto a photosensitive substrate in an overlapping manner, so as to expose a pattern larger than said transfer pattern of said mask onto said photosensitive substrate;

said exposure apparatus comprising:

a light source unit for supplying illumination light; and

an illumination optical system for guiding said illumination light to said mask having said transfer pattern;

said illumination optical system comprising:

an illumination area defining unit, disposed at a position substantially optically conjugate with said mask, for defining a predetermined area corresponding to an illumination area to be formed on said mask; and

an imaging optical system for forming said illumination area on said mask by projecting said predetermined area defined by said illumination area defining unit onto said mask;

said exposure apparatus further comprising:

an adjusting unit for adjusting an optical characteristic in said illumination area formed on said mask or in an exposure area formed on said photosensitive substrate.

2. An exposure apparatus according to claim 1,

further comprising a projection optical system for projecting an image of said transfer pattern of said mask onto an exposure area on said photosensitive substrate.

3. An exposure apparatus according to claim 2, wherein said exposure apparatus satisfies an expression of:

$$0.01 < NA1/(NA2 \times \beta) < 6$$

where NA1 is the maximum numerical aperture of said imaging optical system on said illumination area defining unit side, β is the absolute value of imaging magnification of said imaging optical system, and NA2 is the maximum numerical aperture of said projection optical system on said photosensitive substrate side.

4. An exposure apparatus according to claim 3, wherein said exposure apparatus satisfies an expression of:

$$0.01 < NA1/(NA2 \times \beta) < 4 .$$

5. An exposure apparatus according to claim 1, wherein said illumination area defining unit causes said illumination area formed on said mask to become variable.

6. An exposure apparatus according to claim 1, wherein said adjusting unit adjusts at least one of imaging magnification, distortion, curvature of field, astigmatism, spherical aberration, coma, image surface tilting, decentering distortion, decentering coma, and decentering astigmatic difference in said imaging optical system.

7. An exposure apparatus according to claim 1, wherein said adjusting unit adjusts at least one of an

illuminating angle with respect to a center of gravity of a luminous flux onto said mask or onto said photosensitive substrate, and unevenness of illumination on said mask or on said photosensitive substrate.

8. An exposure apparatus according to claim 1, wherein said adjusting unit carries out adjustment by at least one of moving at least one of said illumination area defining unit and at least a part of said imaging optical system along an optical axis, shifting at least one of said illumination area defining unit and at least a part of said imaging optical system within a plane orthogonal to said optical axis, tilting at least one of said illumination area defining unit and at least a part of said imaging optical system with respect to said optical axis, and rotating at least one of said illumination area defining unit and at least a part of said imaging optical system about said optical axis.

9. An exposure apparatus according to claim 1, wherein said adjusting unit moves or tilts each of a first lens or first lens group for adjusting said optical characteristic, and a second lens or second lens group for correcting an optical characteristic deteriorated in accordance with the adjustment of said optical characteristic.

10. An exposure apparatus according to claim 1, further comprising a measuring unit for measuring an optical

characteristic in said illumination area formed on said mask or in said exposure area formed on said photosensitive substrate so as to obtain an optical characteristic of said imaging optical system.

11. An exposure apparatus according to claim 1, wherein said adjusting unit adjusts at least one of imaging magnification, distortion, curvature of field, astigmatism, spherical aberration, coma, image surface tilting, decentering distortion, decentering coma, and decentering astigmatic difference in said imaging optical system by at least one of moving at least one lens constituting said imaging optical system along an optical axis, shifting said at least one lens along a plane orthogonal to said optical axis, tilting said at least one lens with respect to said optical axis, and rotating said at least one lens about said optical axis.

12. An exposure apparatus according to claim 1, further comprising a measuring unit for measuring said optical characteristic;

wherein said adjusting unit carries out said adjustment based on a result of measurement obtained by said measuring unit.

13. An exposure apparatus according to claim 1, further comprising a moving unit for moving at least one of said photosensitive substrate and said mask to a position where exposure partly overlaps an already exposed area so as to carry out said exposure in an overlapping manner.

14. An exposure apparatus for exposing a transfer pattern of a mask onto a photosensitive substrate;

said exposure apparatus comprising:

a light source unit for supplying illumination light;

an illumination optical system for guiding said illumination light supplied by said light source unit to said mask having said transfer pattern; and

a projection optical system for projecting an image of said transfer pattern of said mask onto an exposure area formed on said photosensitive substrate;

said illumination optical system comprising:

an illumination area defining unit, disposed at a position substantially optically conjugate with said mask, for defining a predetermined area corresponding to an illumination area to be formed on said mask, and an imaging optical system for forming said illumination area on said mask by projecting said predetermined area defined by said illumination area defining unit onto said mask;

said exposure apparatus further comprising:

an adjusting unit for adjusting an optical characteristic in said illumination area formed on said mask or in said exposure area formed on said photosensitive substrate;

said exposure apparatus satisfying an expression of:

$$0.01 < NA1/(NA2 \times \beta) < 6$$

where NA1 is the maximum numerical aperture of said

imaging optical system on said illumination area defining unit side, β is the absolute value of imaging magnification of said imaging optical system, and NA2 is the maximum numerical aperture of said projection optical system on said photosensitive substrate side.

15. An exposure apparatus according to claim 14, wherein said exposure apparatus satisfies an expression of:

$$0.01 < NA1/(NA2 \times \beta) < 4 .$$

16. An exposure apparatus according to claim 14, wherein said adjusting unit adjusts at least one of imaging magnification, distortion, curvature of field, astigmatism, spherical aberration, coma, image surface tilting, decentering distortion, decentering coma, and decentering astigmatic difference in said imaging optical system.

17. An exposure apparatus according to claim 14, wherein said adjusting unit adjusts at least one of an illuminating angle with respect to a center of gravity of a luminous flux onto said mask or onto said photosensitive substrate, and unevenness of illumination on said mask or on said photosensitive substrate.

18. An exposure apparatus according to claim 14, wherein said adjusting unit carries out adjustment by at least one of moving at least one of said illumination area defining unit and at least a part of said imaging optical system along an optical axis, shifting at least one of said illumination area defining unit and at least a part of said

imaging optical system within a plane orthogonal to said optical axis, tilting at least one of said illumination area defining unit and at least a part of said imaging optical system with respect to said optical axis, and rotating at least one of said illumination area defining unit and at least a part of said imaging optical system about said optical axis.

19. An exposure apparatus according to claim 14, wherein said adjusting unit moves or tilts each of a first lens or first lens group for adjusting said optical characteristic, and a second lens or second lens group for correcting an optical characteristic deteriorated in accordance with the adjustment of said optical characteristic.

20. An exposure apparatus according to claim 14, further comprising a measuring unit for measuring an optical characteristic in said illumination area formed on said mask or in said exposure area formed on said photosensitive substrate so as to obtain an optical characteristic of said imaging optical system.

21. An exposure apparatus according to claim 14, wherein said adjusting unit adjusts at least one of imaging magnification, distortion, curvature of field, astigmatism, spherical aberration, coma, image surface tilting, decentering distortion, decentering coma, and decentering astigmatic difference in said imaging optical system by at

least one of moving at least one lens constituting said imaging optical system along an optical axis, shifting said at least one lens along a plane orthogonal to said optical axis, tilting said at least one lens with respect to said optical axis, and rotating said at least one lens about said optical axis.

22. An exposure apparatus according to claim 14, further comprising a measuring unit for measuring said optical characteristic;

wherein said adjusting unit carries out said adjustment based on measurement effect obtained said measuring unit.

23. An exposure apparatus according to claim 14, further comprising a changing unit for changing at least one of size and form of said illumination light at a pupil of said illumination optical system.

24. An exposure apparatus according to claim 23, wherein said adjusting unit adjusts said optical characteristic changed by said changing unit.

25. An exposure apparatus according to claim 14, further comprising a scanning unit for moving said mask and said photosensitive substrate relative to said projection optical system along a predetermined scanning direction so as to expose an image of said transfer pattern of said mask onto said photosensitive substrate in a scanning manner;

said illumination optical system including:

an optical integrator, disposed between said changing unit and said illumination area defining unit, for

illuminating said mask with illumination light by way of said changing unit;

said optical integrator being arranged such that a direction optically corresponding to a shorter side direction of a cross section of said optical integrator perpendicular to an optical axis or a shorter side direction of a cross section of a number of optical elements constituting said optical integrator perpendicular to said optical axis coincides with said scanning direction.

26. An exposure apparatus comprising:

an illumination optical system including an illumination area forming optical system for forming an illumination area on a mask having a predetermined pattern;

a projection optical system for projecting a pattern image of said mask onto a photosensitive substrate; and

an adjusting unit for adjusting said illumination optical system;

said exposure apparatus satisfying an expression of:

$$0.01 < NA1/(NA2 \times \beta) < 6$$

where NA1 is the maximum numerical aperture of said illumination area forming optical system on a light source side, β is the imaging magnification of said illumination area forming optical system, and NA2 is the maximum numerical aperture of said projection optical system on said photosensitive substrate side.

27. An exposure apparatus according to claim 26,

wherein said adjusting unit adjusts at least one of a number of optical members constituting said illumination area forming optical system.

28. A method of manufacturing a microdevice by using the exposure apparatus of claim 1;

said method comprising:

an illumination step of illuminating said mask by using said illumination optical system; and

an exposure step of exposing a transfer pattern formed in said mask onto said photosensitive substrate.

29. A method of manufacturing a microdevice by using the exposure apparatus of claim 14;

said method comprising:

an illumination step of illuminating said mask by using said illumination optical system; and

an exposure step of exposing a transfer pattern formed in said mask onto said photosensitive substrate.

30. A method of manufacturing a microdevice,

said method comprising:

an illumination step of illuminating a mask having a transfer pattern with illumination light; and

an exposure step of exposing said transfer pattern of said mask onto a photosensitive substrate in an overlapping manner;

said illumination step including:

an illumination area defining step of defining a

predetermined area corresponding to an illumination area to be formed on a mask at a position substantially optically conjugate with said mask; and

an illumination area forming step of forming said illumination area on said mask by projecting said predetermined area onto said mask by using an imaging optical system;

said method further comprising:

an adjusting step for adjusting an optical characteristic of said imaging optical system prior to said exposure step.

31. A method of manufacturing a microdevice according to claim 30, wherein said exposure step includes a projection step of projecting an image of said transfer pattern of said mask onto an exposure area on said photosensitive substrate by using a projection optical system.

32. A method of manufacturing a microdevice according to claim 31, said imaging optical system and said projection optical system satisfy an expression of:

$$0.01 < NA1/(NA2 \times \beta) < 6$$

where NA1 is the maximum numerical aperture of said imaging optical system on a side opposite from said mask side, β is the absolute value of imaging magnification of said imaging optical system, and NA2 is the maximum numerical aperture of said projection optical system on said

photosensitive substrate side.

33. A method of manufacturing a microdevice according to claim 32, said method satisfies an expression of:

$$0.01 < NA1/(NA2 \times \beta) < 4 .$$

34. A method of manufacturing a microdevice according to claim 30, wherein said illumination area defining step includes a changing step of changing said illumination area formed on said mask; and

wherein said adjusting step includes adjusting an optical characteristic of said imaging optical system according to a change in said illumination area caused by said changing step.

35. A method of manufacturing a microdevice according to claim 30, further comprising a measuring step of measuring an optical characteristic in said illumination area formed on said mask or in an exposure area formed on said photosensitive substrate;

wherein said adjusting step includes adjusting an optical characteristic of said imaging optical system according to a result of measurement obtained by said measuring step.

36. A method of manufacturing a microdevice;

said method comprising:

an illumination step of illuminating a mask having a transfer pattern with illumination light; and

an exposure step of exposing said transfer pattern of said mask onto a photosensitive substrate;

said exposure step including a projection step of projecting said transfer pattern of said mask onto said photosensitive substrate by using a projection optical system;

said illumination step including:

an illumination area defining step of defining a predetermined area corresponding to an illumination area to be formed on said mask at a position substantially optically conjugate with said mask; and

an illumination area forming step of forming said illumination area on said mask by projecting said predetermined area onto said mask by using an imaging optical system;

said method satisfying an expression of:

$$0.01 < NA1/(NA2 \times \beta) < 6$$

where NA1 is the maximum numerical aperture of said imaging optical system on a side opposite from said mask side, β is the absolute value of imaging magnification of said imaging optical system, and NA2 is the maximum numerical aperture of said projection optical system on said photosensitive substrate side;

said method further comprising an adjusting step for adjusting an optical characteristic of said imaging optical system prior to said exposure step.

37. A method of manufacturing a microdevice according to claim 36, said method satisfies an expression of:

$$0.01 < NA1/(NA2 \times \beta) < 4 .$$

38. A method of manufacturing a microdevice according to claim 36, wherein said illumination area defining step includes a changing step of changing said illumination area formed on said mask; and

wherein said adjusting step includes adjusting an optical characteristic of said imaging optical system according to a change in said illumination area caused by said changing step.

39. A method of manufacturing a microdevice according to claim 36, further comprising a measuring step of measuring an optical characteristic in said illumination area formed on said mask or in an exposure area formed on said photosensitive substrate;

wherein said adjusting step includes adjusting an optical characteristic of said imaging optical system according to a result of measurement obtained by said measuring step.

40. A method of manufacturing a microdevice according to claim 36, wherein said illumination step includes a changing step of changing at least one of the size and form of illumination light at a pupil of an illumination optical system.

41. A method of manufacturing a microdevice according to claim 40, wherein said adjusting step includes a step of adjusting said optical characteristic changed by said changing step.

42. A method of manufacturing a microdevice according to claim 36, wherein said illumination step includes a uniform illumination step of uniformly illuminating said mask by way of an optical integrator; and

wherein said exposure step includes a scanning exposure step of exposing an image of said transfer pattern of said mask onto said photosensitive substrate in a scanning manner by moving said mask and said photosensitive substrate relative to said projection optical system along a predetermined direction optically corresponding to a shorter side direction of a cross section of said optical integrator perpendicular to an optical axis or a shorter side direction of a cross section of a number of optical elements constituting said optical integrator perpendicular to said optical axis.

43. A method of manufacturing a microdevice, said method comprising:

a step of illuminating a mask having a predetermined pattern by using an illumination optical system including an illumination area forming optical system for forming an illumination area on said mask;

a step of exposing a photosensitive substrate by using a projection optical system for projecting a pattern image

of said mask onto said photosensitive substrate; and

a step of adjusting said illumination optical system;

said method satisfying an expression of:

$$0.01 < NA1/(NA2 \times \beta) < 6$$

where NA1 is the maximum numerical aperture of said illumination area forming optical system on a light source side, β is the imaging magnification of said illumination area forming optical system, and NA2 is the maximum numerical aperture of said projection optical system on said photosensitive substrate side.

44. A method of manufacturing a microdevice according to claim 43, further comprising a changing step of changing at least one of the size and form of illumination light at a pupil of said illumination optical system;

wherein said adjusting step adjusts said optical characteristic according to said changing step.

45. A method of manufacturing a microdevice according to claim 43, further comprising a changing step of changing said illumination area formed on said mask;

wherein said adjusting step adjusts said optical characteristic according to said changing step.

46. A method of manufacturing an exposure apparatus, comprising an illumination optical system for illuminating a mask having a transfer pattern with illumination light, and a projection optical system for projecting a transfer pattern image of said mask onto a photosensitive substrate,

for exposing said transfer pattern of said mask onto said photosensitive substrate in an overlapping manner so as to expose a pattern larger than said transfer pattern on said mask onto said photosensitive substrate;

said method comprising:

an aberration correcting step of correcting a rotationally asymmetrical aberration or decentering aberration remaining in said illumination optical system; and

an adjusting step of adjusting an optical characteristic deteriorated by said aberration correcting step.

47. A method of manufacturing an exposure apparatus according to claim 46, wherein said exposure apparatus satisfies an expression of:

$$0.01 < NA1/(NA2 \times \beta) < 6$$

where NA1 is the maximum numerical aperture of said imaging optical system included in said illumination optical system on a side opposite from said mask side, β is the absolute value of imaging magnification of said imaging optical system, and NA2 is the maximum numerical aperture of said projection optical system on said photosensitive substrate side.

48. A method of manufacturing an exposure apparatus according to claim 47, wherein said exposure apparatus satisfies an expression of:

$$0.01 < NA1/(NA2 \times \beta) < 4 .$$

49. A method of manufacturing an exposure apparatus according to claim 46, wherein said adjusting step includes a telecentricity adjusting step of adjusting a deterioration of telecentricity on said mask or on said photosensitive substrate.

50. A method of manufacturing an exposure apparatus according to claim 46, wherein said adjusting step includes an illumination surface correcting step of correcting a rotation or inclination of an illumination surface of said illumination optical system formed on said mask or on said photosensitive substrate.

51. A method of manufacturing an exposure apparatus according to claim 50, wherein said illumination surface has an image of a predetermined area defined by an illumination area defining unit disposed within said illumination optical system.

52. A method of manufacturing an exposure apparatus according to claim 46, further comprising a step of measuring an aberration remaining in said illumination optical system.

53. A method of manufacturing an exposure apparatus, comprising an illumination optical system for illuminating a mask having a transfer pattern with illumination light, and a projection optical system for projecting a transfer pattern image of said mask onto a photosensitive substrate, for exposing said transfer pattern of said mask onto said photosensitive substrate;

said method comprising:

an aberration correcting step of correcting a rotationally asymmetrical aberration or decentering aberration remaining in said illumination optical system; and

an adjusting step of adjusting an optical characteristic deteriorated by said aberration correcting step;

said method satisfying an expression of:

$$0.01 < NA1/(NA2 \times \beta) < 6$$

where NA1 is the maximum numerical aperture of an imaging optical system included in said illumination optical system on a side opposite from said mask side, β is the absolute value of imaging magnification of said imaging optical system, and NA2 is the maximum numerical aperture of said projection optical system on said photosensitive substrate side.

54. A method of manufacturing an exposure apparatus according to claim 53, wherein said method satisfies an expression of:

$$0.01 < NA1/(NA2 \times \beta) < 4 .$$

55. A method of manufacturing an exposure apparatus according to claim 53, wherein said adjusting step includes a telecentricity adjusting step of adjusting a deterioration of telecentricity on said mask or on said photosensitive substrate.

56. A method of manufacturing an exposure apparatus

according to claim 53, wherein said adjusting step includes an illumination surface correcting step of correcting a rotation or inclination of an illumination surface of said illumination optical system formed on said mask or on said photosensitive substrate.

57. A method of manufacturing an exposure apparatus according to claim 56, wherein said illumination surface has an image of a predetermined area defined by an illumination area defining unit disposed within said illumination optical system.

58. A method of manufacturing an exposure apparatus according to claim 53, further comprising a step of measuring an aberration remaining in said illumination optical system.

59. A method of manufacturing an exposure apparatus comprising an illumination optical system for illuminating a mask having a transfer pattern with illumination light, and a projection optical system for projecting a transfer pattern image of said mask onto a photosensitive substrate;

said method comprising:

a measuring step of measuring an optical characteristic in an illumination area formed on said mask or an exposure area formed on said photosensitive substrate;

a first aberration correcting step of correcting a rotationally symmetrical aberration remaining in said illumination optical system according to a result of measurement obtained by said measuring step; and

a second aberration correcting step of correcting a rotationally asymmetrical aberration remaining in said illumination optical system according to a result of measurement obtained by said measuring step.

60. A method of manufacturing an exposure apparatus according to claim 59, wherein said measuring step includes:

a preliminary exposure step of preliminary exposing a test pattern disposed at a position substantially optically conjugate with said mask or at the same position as said mask onto said photosensitive substrate; and

an analyzing step of analyzing said test pattern exposed onto said photosensitive substrate based on a result of said preliminary exposure step.

61. A method of manufacturing an exposure apparatus according to claim 59, wherein said measuring step includes a photoelectric detecting step of photoelectrically detecting an optical characteristic at a position substantially optically conjugate with said mask, at the same position as said mask, or at the same position as said photosensitive substrate.

62. A method of manufacturing an exposure apparatus according to claim 59, further comprising an adjusting step of adjusting an optical characteristic of said illumination optical system deteriorated in accordance with at least one of corrections effected by said first and second aberration correcting steps.

63. A method of manufacturing an exposure apparatus according to claim 59, wherein said method satisfies an expression of:

$$0.01 < NA1/(NA2 \times \beta) < 6$$

where NA1 is the maximum numerical aperture of an imaging optical system included in said illumination optical system on a side opposite from said mask side, β is the absolute value of imaging magnification of said imaging optical system, and NA2 is the maximum numerical aperture of said projection optical system on said photosensitive substrate side.

64. A method of manufacturing an exposure apparatus according to claim 63, wherein said method satisfies an expression of:

$$0.01 < NA1/(NA2 \times \beta) < 4\ .$$

65. A method of manufacturing an exposure apparatus according to claim 59, wherein said exposure apparatus exposes a pattern larger than said transfer pattern of said mask onto said photosensitive substrate by exposing said transfer pattern of said mask onto said photosensitive substrate in an overlapping manner.

66. A method of manufacturing an exposure apparatus for exposing a pattern formed in a mask onto a photosensitive substrate;

said method comprising the steps of:

installing an illumination optical system including an illumination area forming optical system for forming an

illumination area on said mask;

installing a projection optical system for projecting a pattern image of said mask onto said photosensitive substrate;

measuring an optical characteristic of said illumination optical system; and

adjusting said illumination optical system;

said method satisfying an expression of:

$$0.01 < NA1/(NA2 \times \beta) < 6$$

where NA1 is the maximum numerical aperture of said illumination area forming optical system on a light source side, β is the imaging magnification of said illumination area forming optical system, and NA2 is the maximum numerical aperture of said projection optical system on said photosensitive substrate side.